Western Aeronautical Test Range

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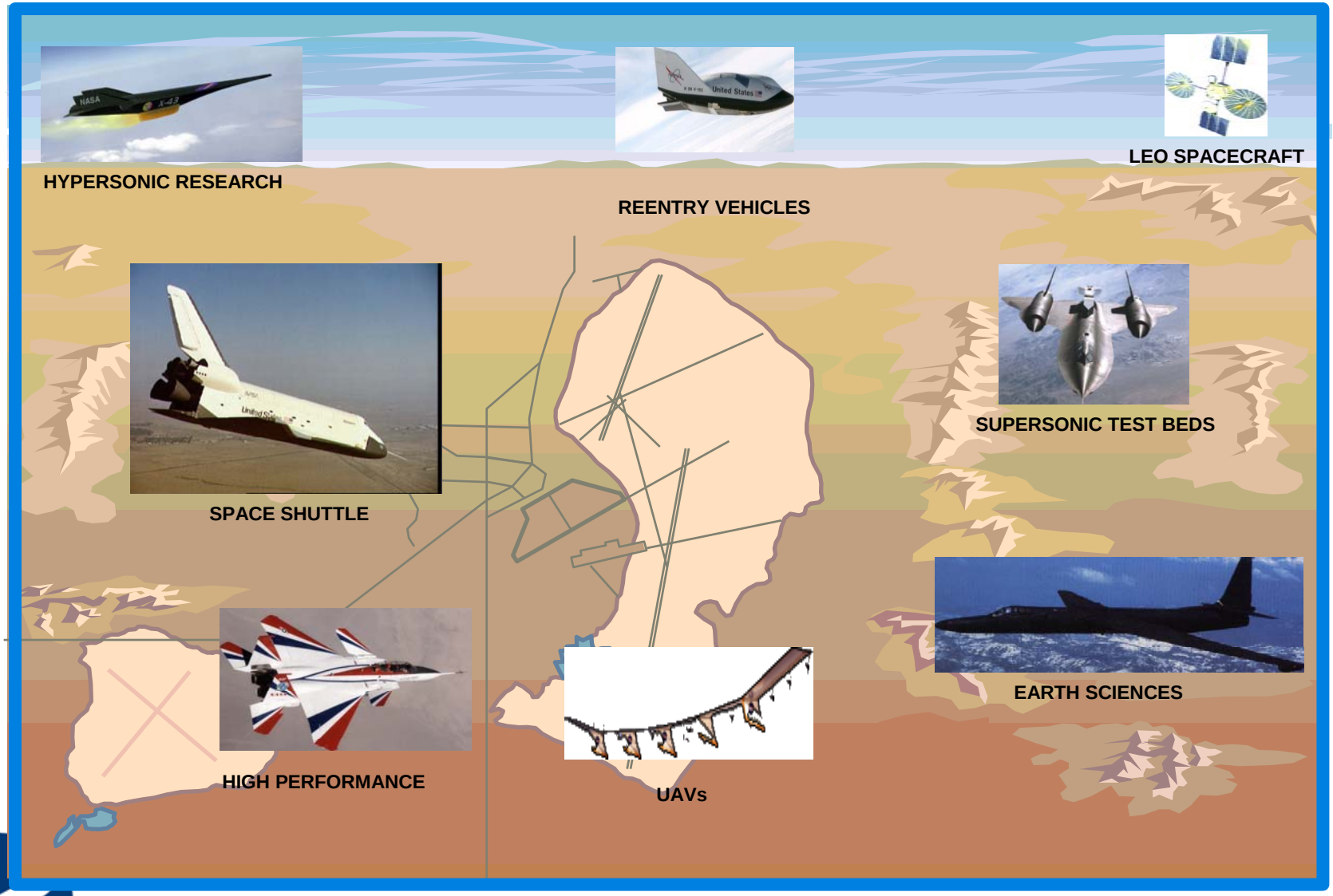
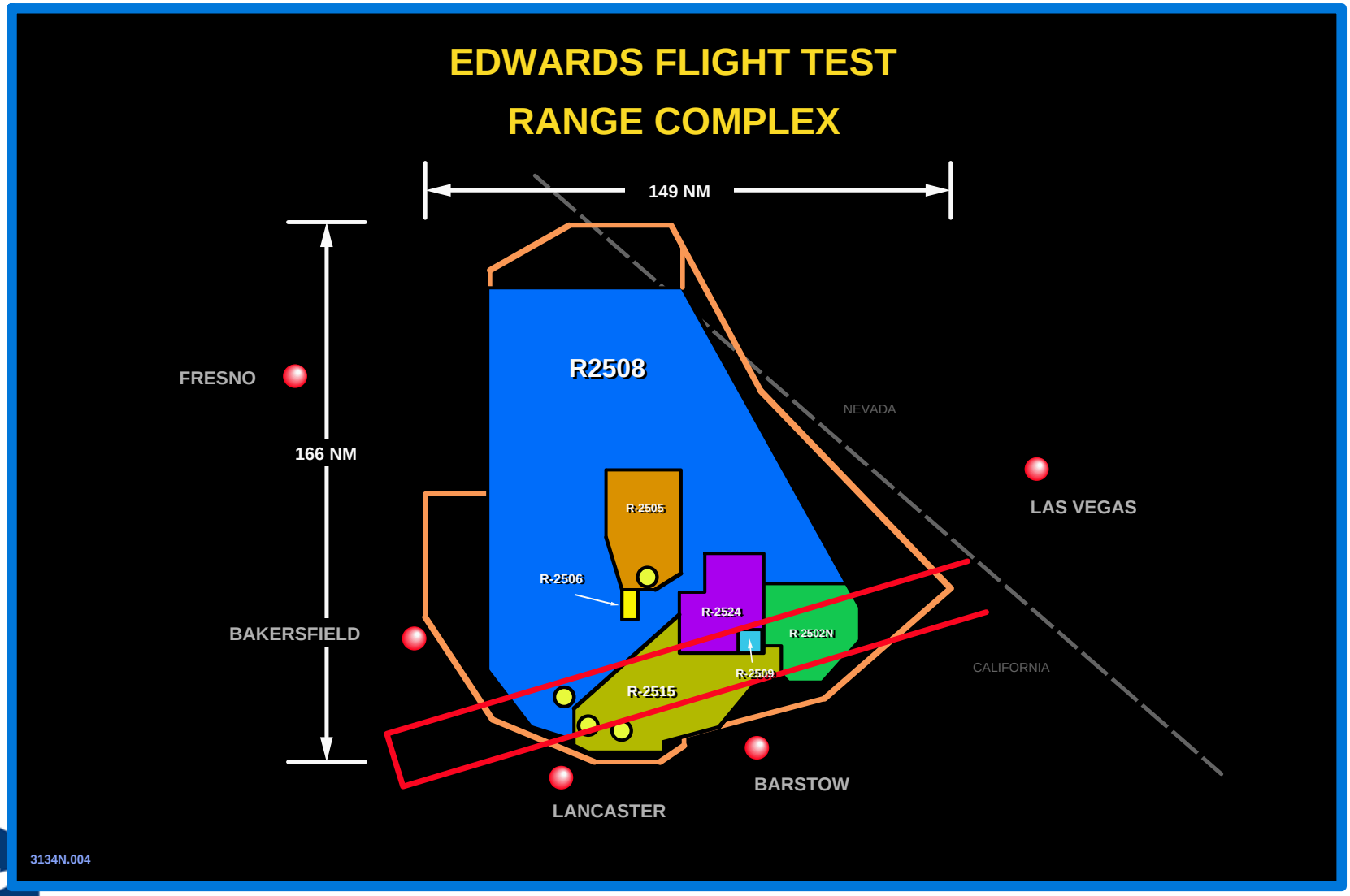
What is the WATR?

- **NASA's Western Aeronautical Test Range (WATR) is a network of facilities used to support research and development of experimental aircraft as well as launch, landing, and on orbit support of the Space Shuttle and other spacecraft.**
- **The WATR is part of NASA's Dryden Flight Research Center located at Edwards Air Force Base, California.**
- **NASA is a tenant on Edwards Air Force Base and has an agreement with the Air Force Flight Test Center to use the land and airspace controlled by the Department of Defense**

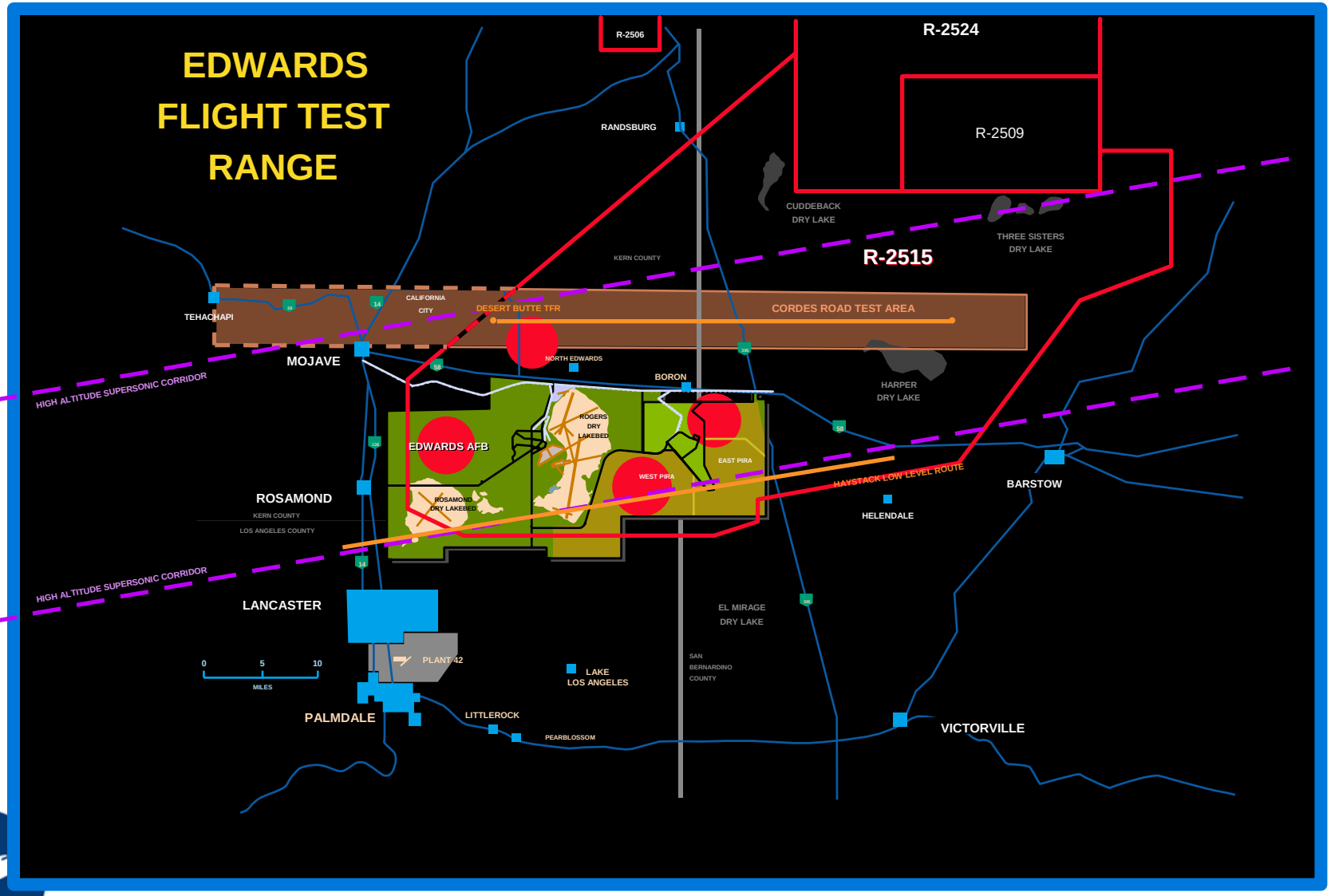
The WATR supports a variety of vehicles



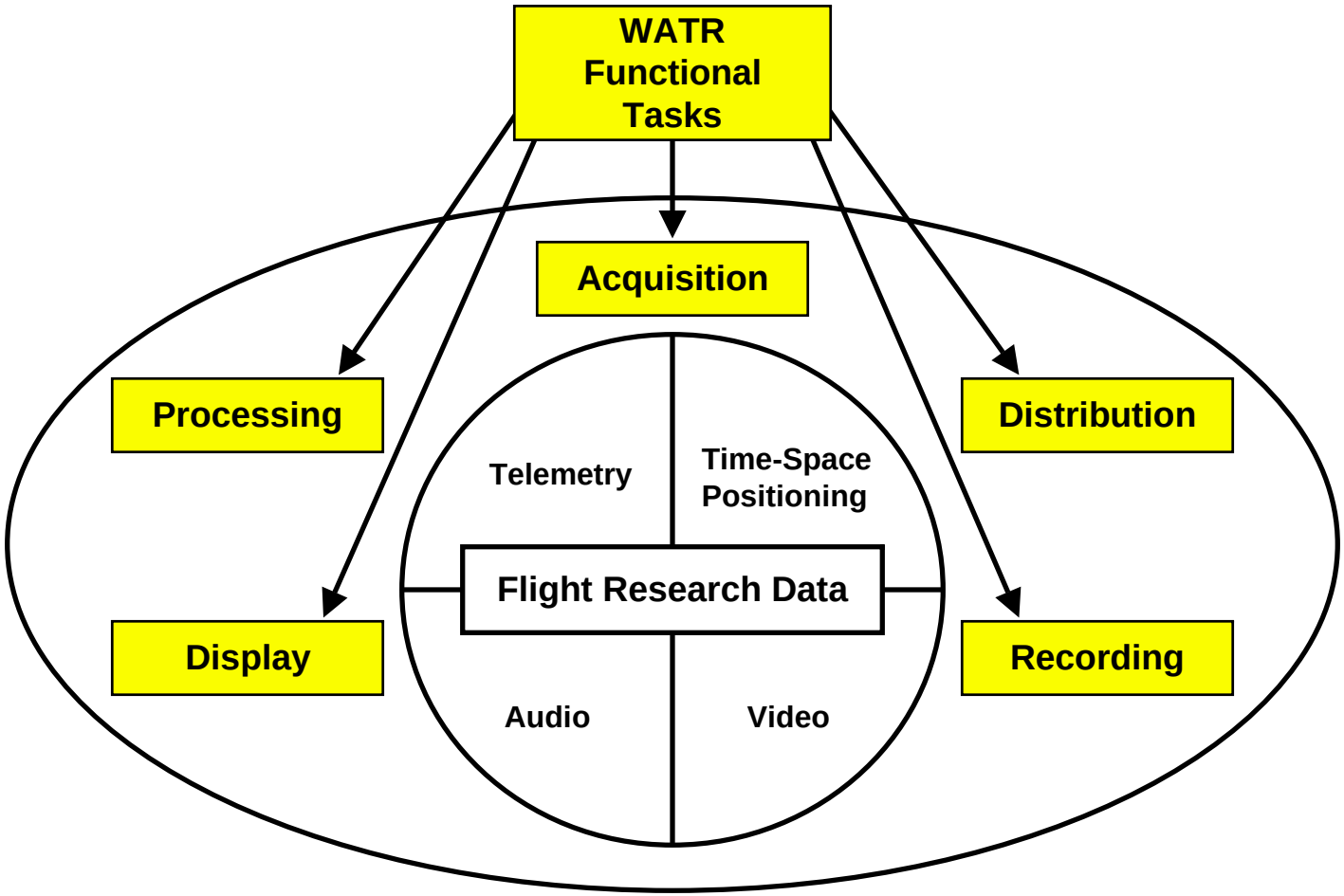
Dryden shares airspace with the AFFTC
~ 12,000 square miles



Restricted airspace, corridors, and special use areas are available for experimental aircraft



The WATR's product is flight research data:



Telemetry Tracking

- Three fixed C-, L-, and S-Band tracking stations and several mobile systems
  - Supports both downlink telemetry and air-to-ground video
  - Command uplink for UAV, RPVs, and piloted vehicles
- One 9-meter S-band tracking station at Dugway Proving Grounds (Utah)
  - Can support high mach flights

Time Space Positioning

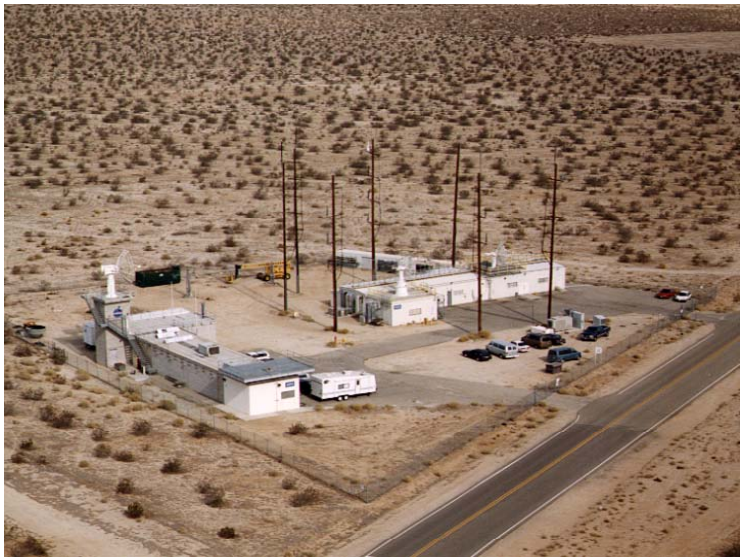
- **Three main types of positioning data**
  - **Precision tracking radars**
    - **> High accuracy RIR-716 C-band radars**
  - **Global Positioning System (GPS)**
    - **> Differential GPS ground station**
  - **FAA radar data**
    - **> Provided via the AFFTC**

Video

- Video tracking, distribution, and recording
  - Long Range Optical (LRO) tracking systems ensure ground controllers maintain visual contact with test vehicle
    - > Broadcast quality video used for data analysis and network feeds
    - > Forward Looking Infra-Red (FLIR) used for night missions
    - > High powered telescope used to view distant targets
  - Video distribution and recording systems
    - > Up to 256 video sources are routed to both internal and external destinations
    - > Video is recorded on multiple video formats

Voice Communication

- Two-way voice communications with aircraft and spacecraft
  - UHF, VHF, and HF radios are used as appropriate
  - High-gain directional antennas are used for distant targets
  - Pilots communicate with ground controllers in the Mission Control Center (MCC)
  - Special equipment for communicating with both the Russian spacecraft (Soyuz) and the International Space Station (ISS)

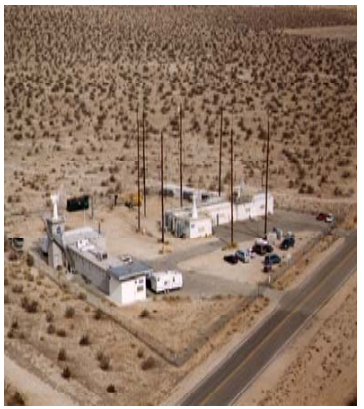


Typical WATR Configuration

Telemetry Tracking

Radar Tracking

Video Tracking



RF Communications

MISSION CONTROL CENTER

Real-time data processing

Real-time data monitoring

Remote user sites

Data Processing

- Pulse Code Modulation (PCM) and Frequency Modulation (FM) data from aircraft is received and decommutated
  - Multiple data streams are received simultaneously
  - Multiple data formats can be transmitted simultaneously or changed during flight
  - Data rates can reach 20 Mbits/sec
- Raw data is then processed
  - Calibrated
  - Concatenated (link multiple data words together to form single word)
  - Combined with radar data
  - Time correlated

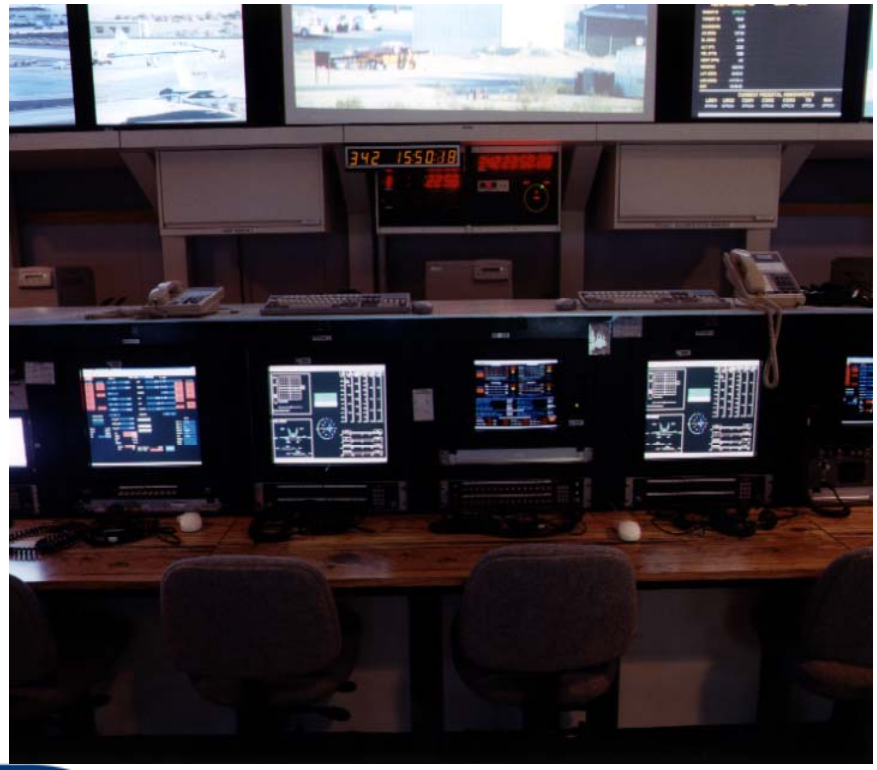
Data Processing (cont.)

- Data is then converted to Engineering Units (EU)
  - Converts data to floating point format (real numbers)
  - Allows Flight Test Engineers to analyze data from a variety of sensors
- Further processing is then applied to the data
  - Derived parameters are calculated
  - Simulation data may be introduced
- Data is then distributed
  - Mission Control Center
  - Archival

Mission Control Center

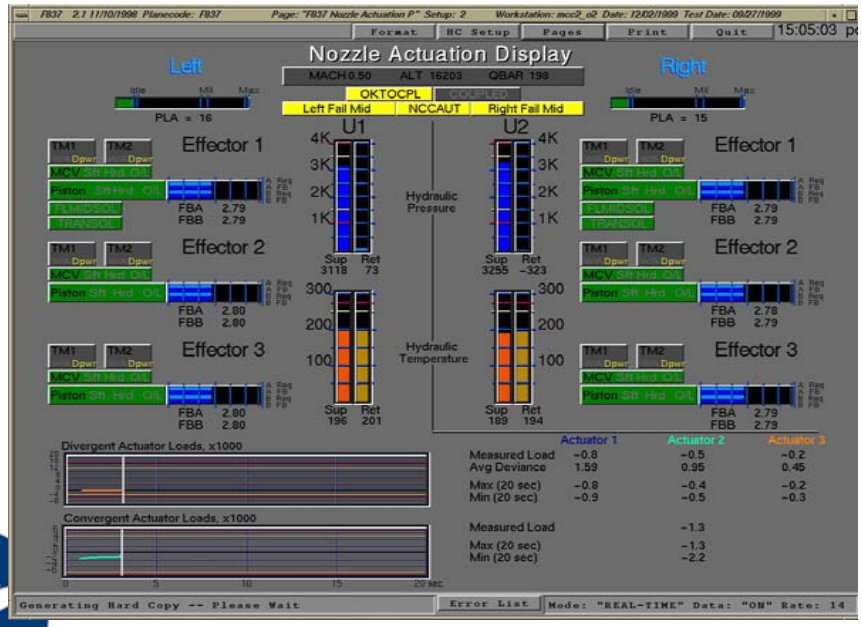
Data Display

- **Test Conductors and Research Engineers monitor the data in real-time**
  - **Thousands of data parameters are monitored in a variety of ways to insure mission success**



Real-Time Data Analysis

- Each mission is rehearsed prior to flight
  - Pilot flies specific maneuvers that have been practiced many times
  - Engineers in the MCC compare actual data to predicted data
    - > Predicted data may be from flight simulators, wind tunnel tests, historical data, or by other means
  - Sometimes there is no way to safely predict what will happen during a specific maneuver
  - After carefully analyzing the data the pilot is told to continue or abort



Range Safety

- Public safety and the safety of our pilots and research aircraft are of the highest priority
  - Range Safety Officers monitor flight critical data as well as space positioning data
  - Close attention is paid to vehicle location as well as predicted debris impact points
  - Pilots are told to Return To Base (RTB) and unpiloted vehicles are deliberately brought down if the vehicle poses any danger to the public